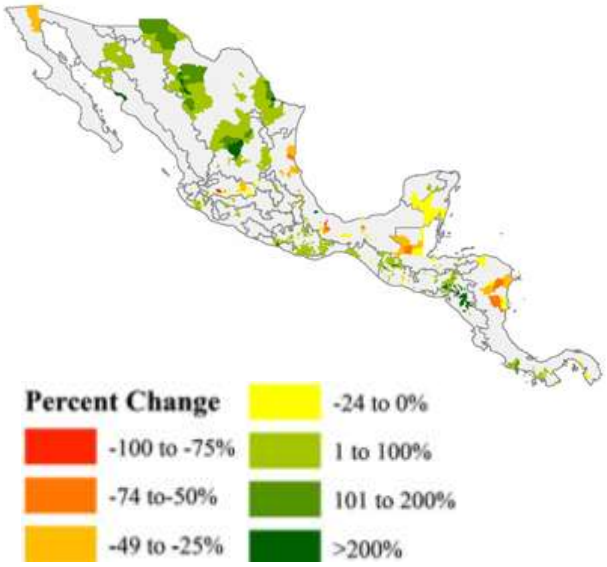
Trends in 15-year MODIS NDVI time series for Mexico

René R. Colditz, Martha Bonilla-Moheno, Rainer A. Ressl

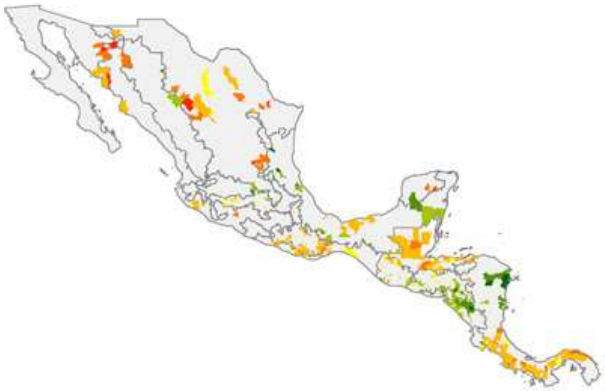
Motivation

- Detection of distinct patterns of land cover change in Mexico at municipality level
  - 250m MODIS MOD13Q1 product from 2001-2010

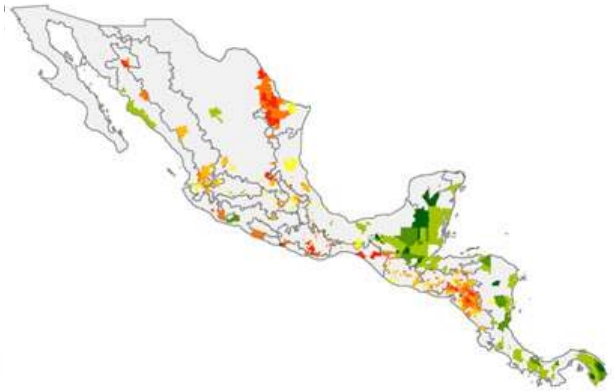
Woody vegetation



Mixed woody / Plantation



Agriculture / herbaceous

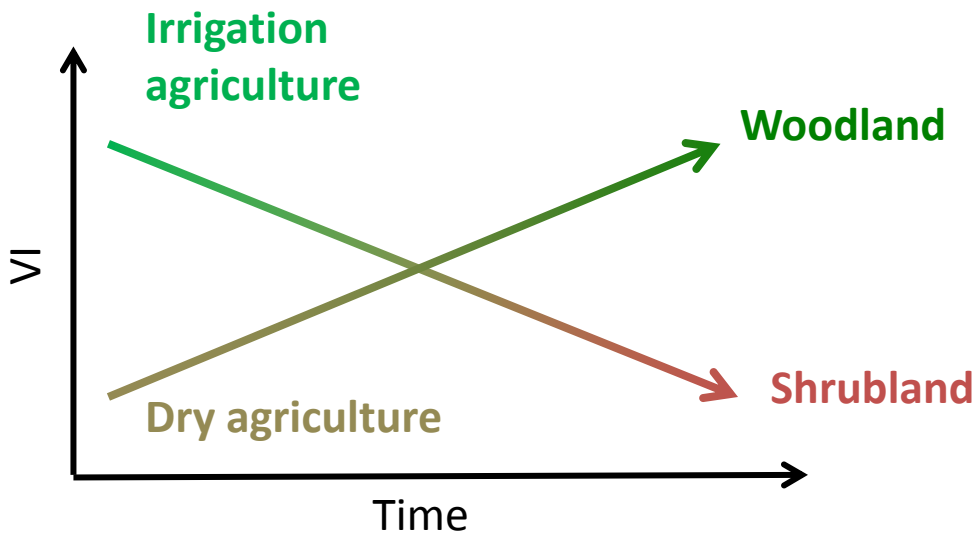


Clark et al 2012 RSE
Bonilla-Moheno et al. 2012 Reg. Env. Change,
Bonilla-Moheno et al. 2013 Land Use Policy

Hypothesis

- Trends in VI time series match trends in land cover change

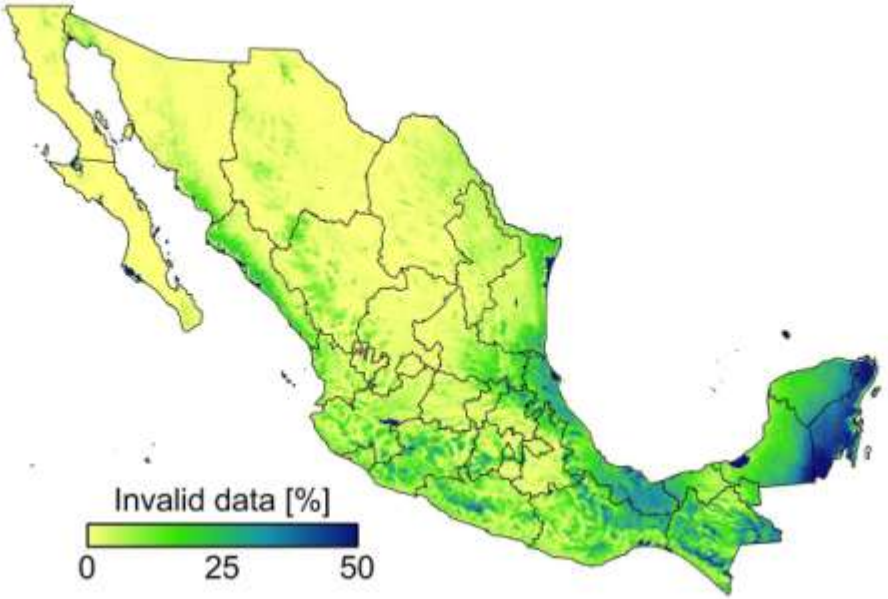
- But:

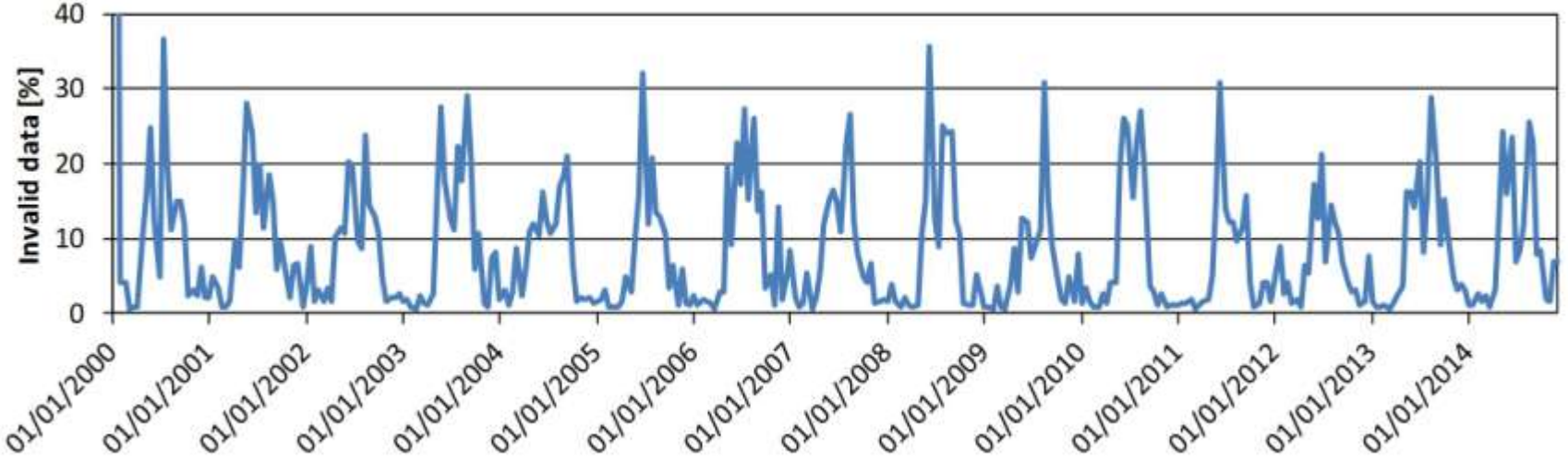


Data and Methods

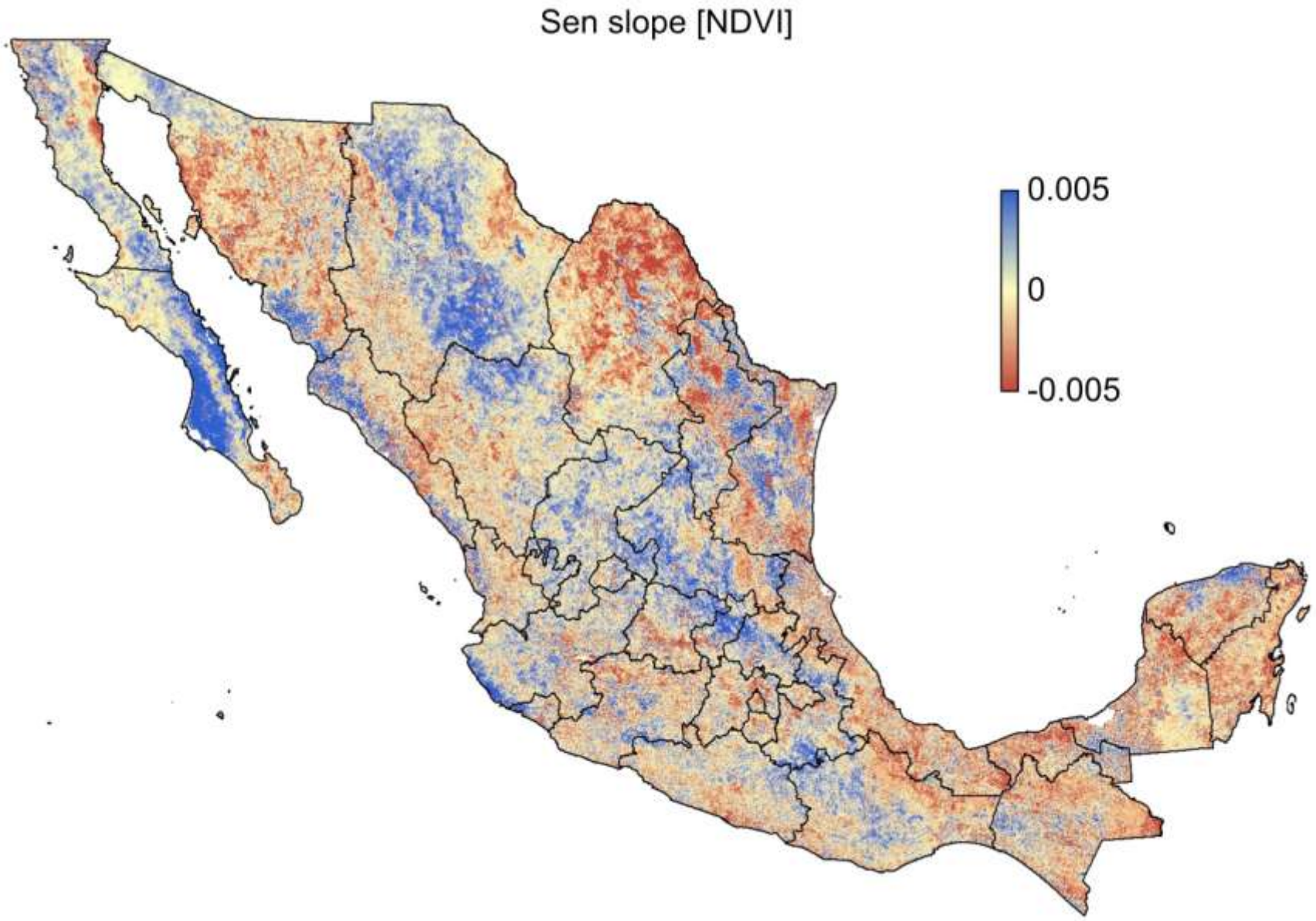
- 250m, 16-day MODIS NDVI from Terra
  - 9 tiles (entire Mexico)
  - 2000-2014
- Projection to LCC
- Quality analysis
- Annual and seasonal averages
- Temporal regression and statistical test
  - Parametric: Linear least-squares and F-test
  - Non-parametric: Theil-Sen and Mann-Kendall test

Quality analysis

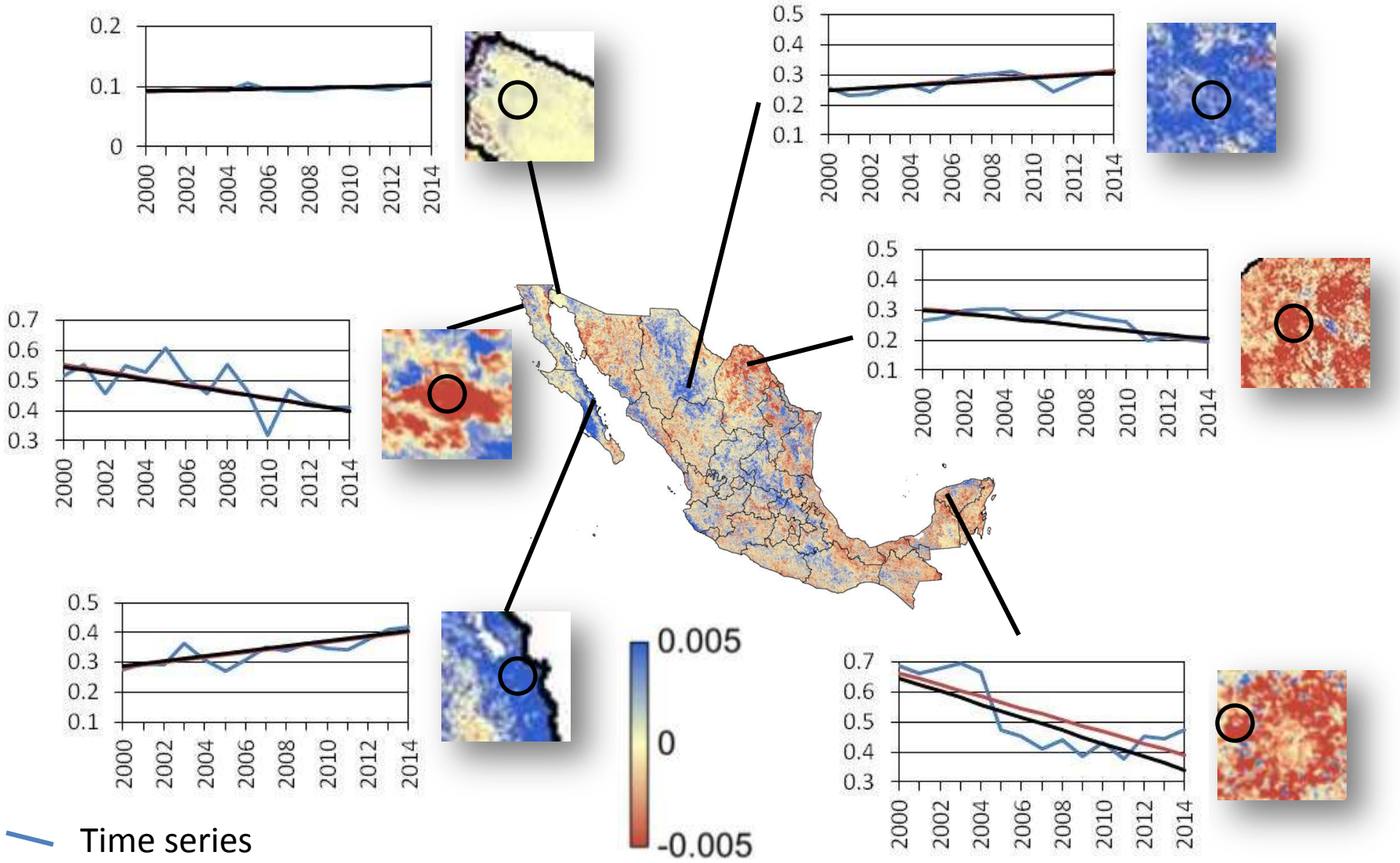




Trends



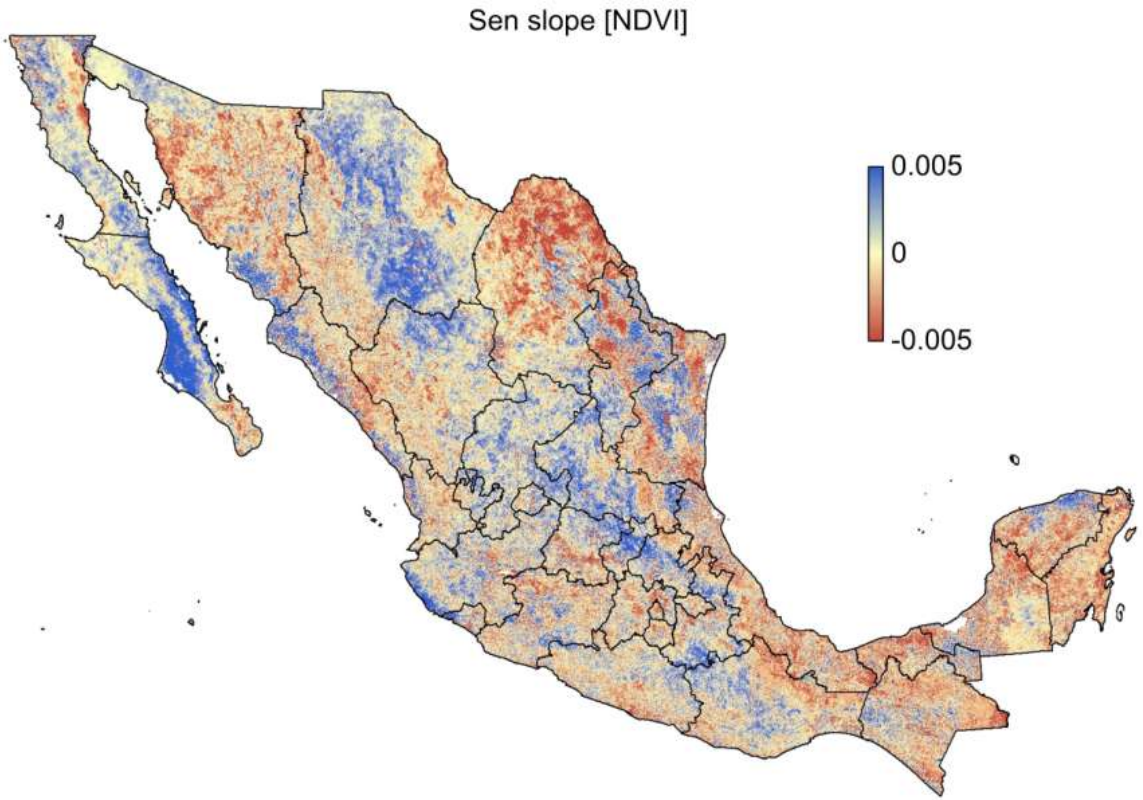
Trends for selected pixels



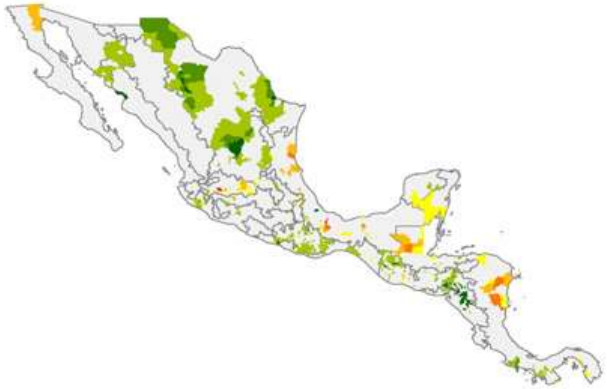
All trends are significant ($p<0.05$)

Trends – Northern Mexico

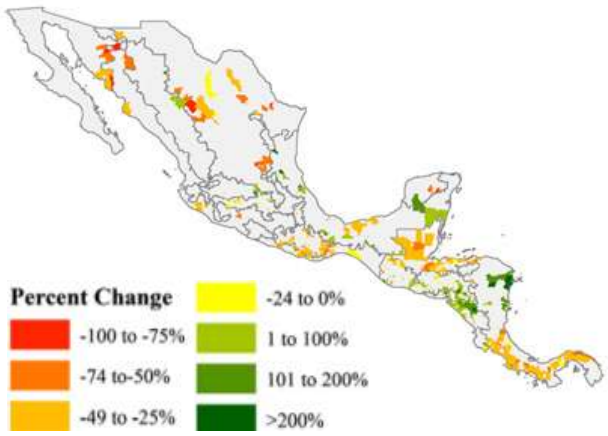
Widespread land cover trends



Woody vegetation



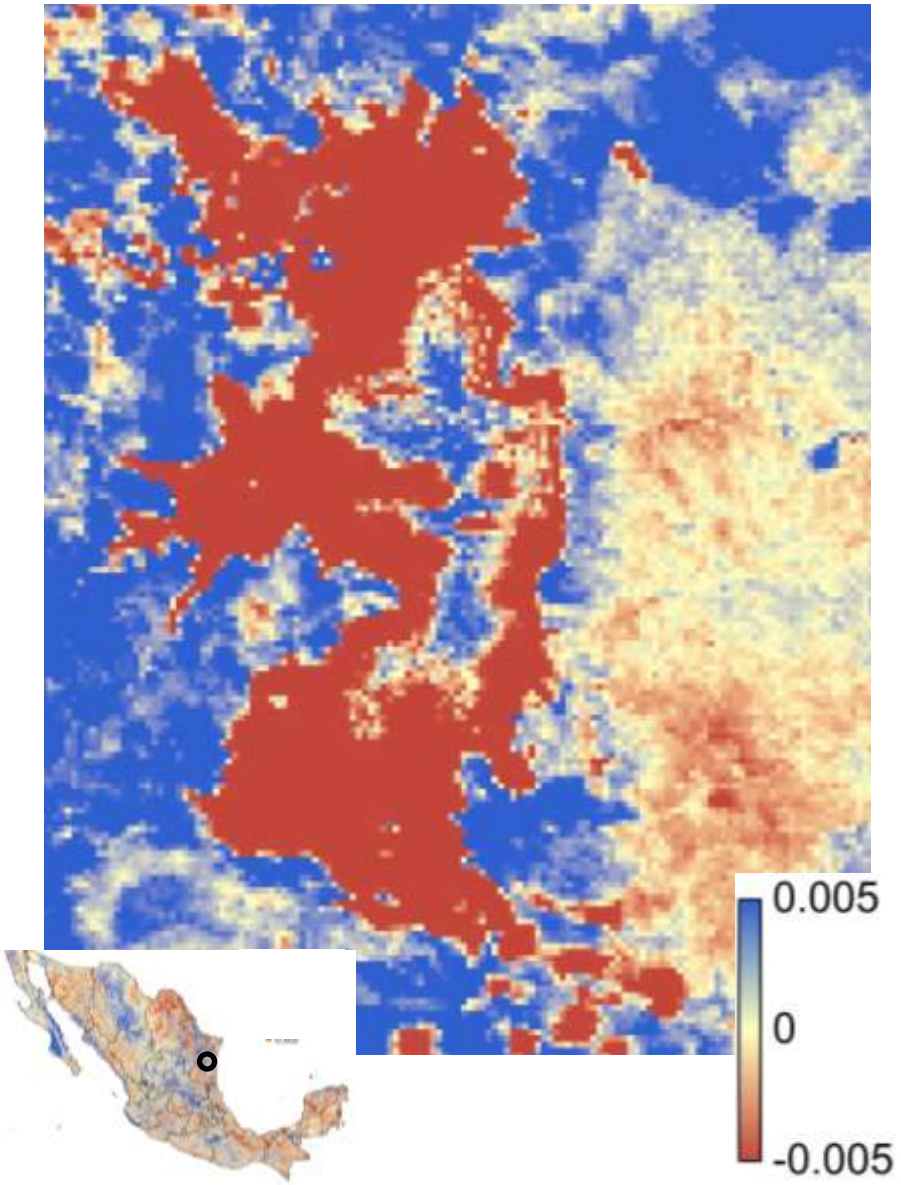
Mixed woody / Plantation

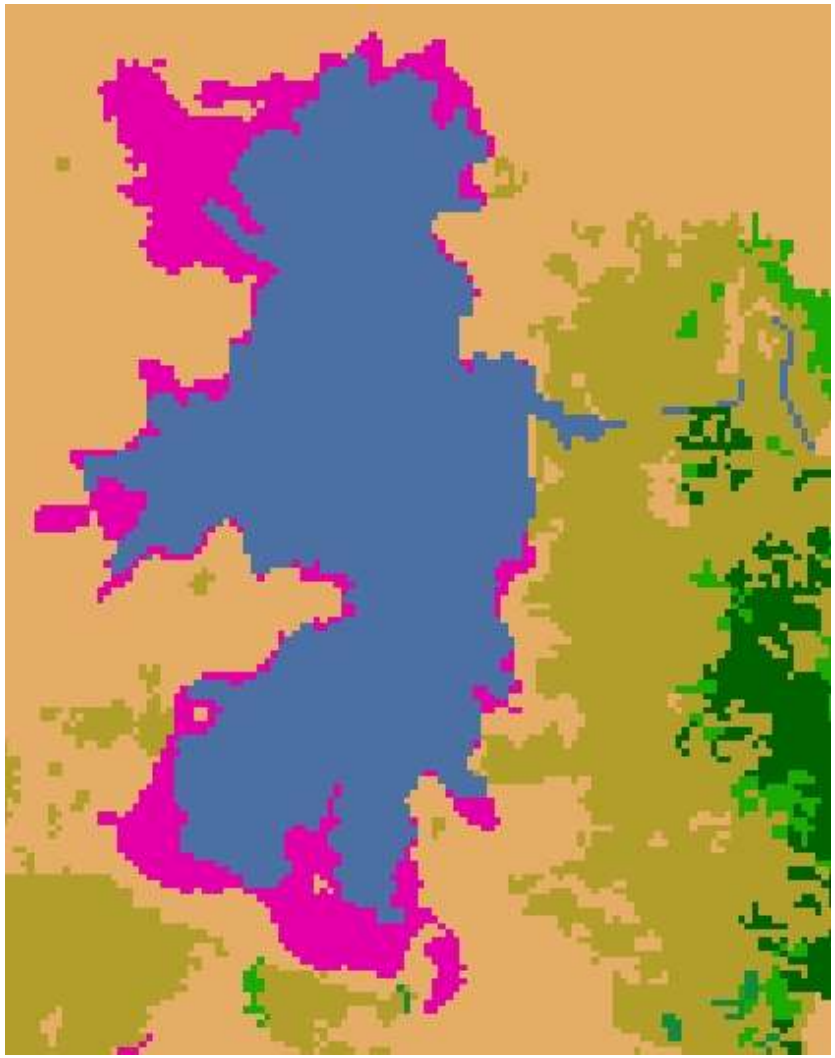


Clark et al 2012 RSE

Trends – Northern Mexico

Vicente Guerrero Reservoir



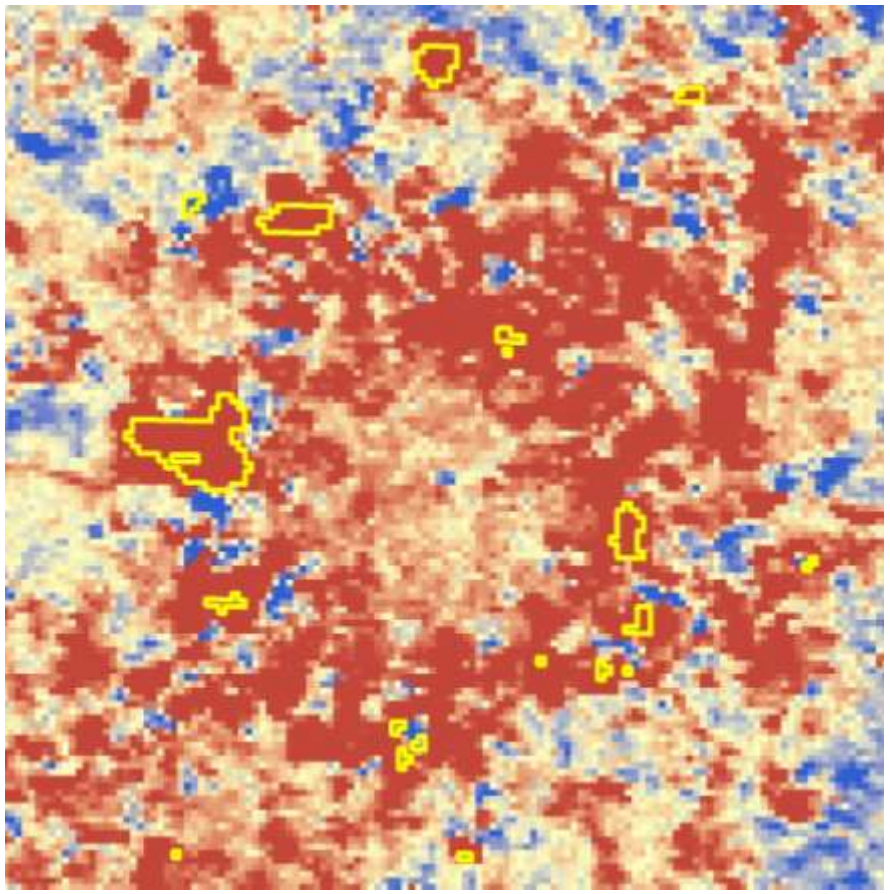


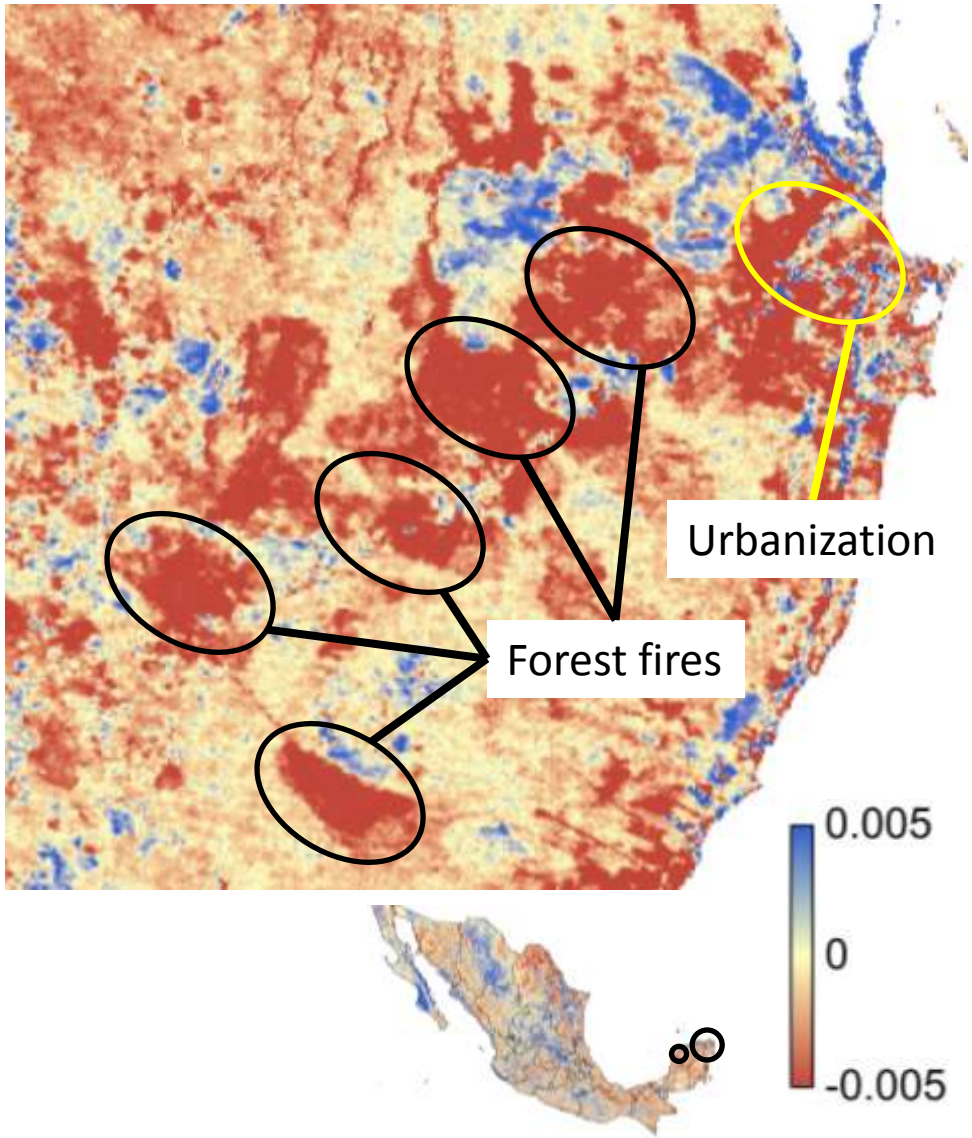
Change between 2005 and 2010
Colditz et al. 2014, PE&RS

Trends – Southern Mexico

Merida

Cancun



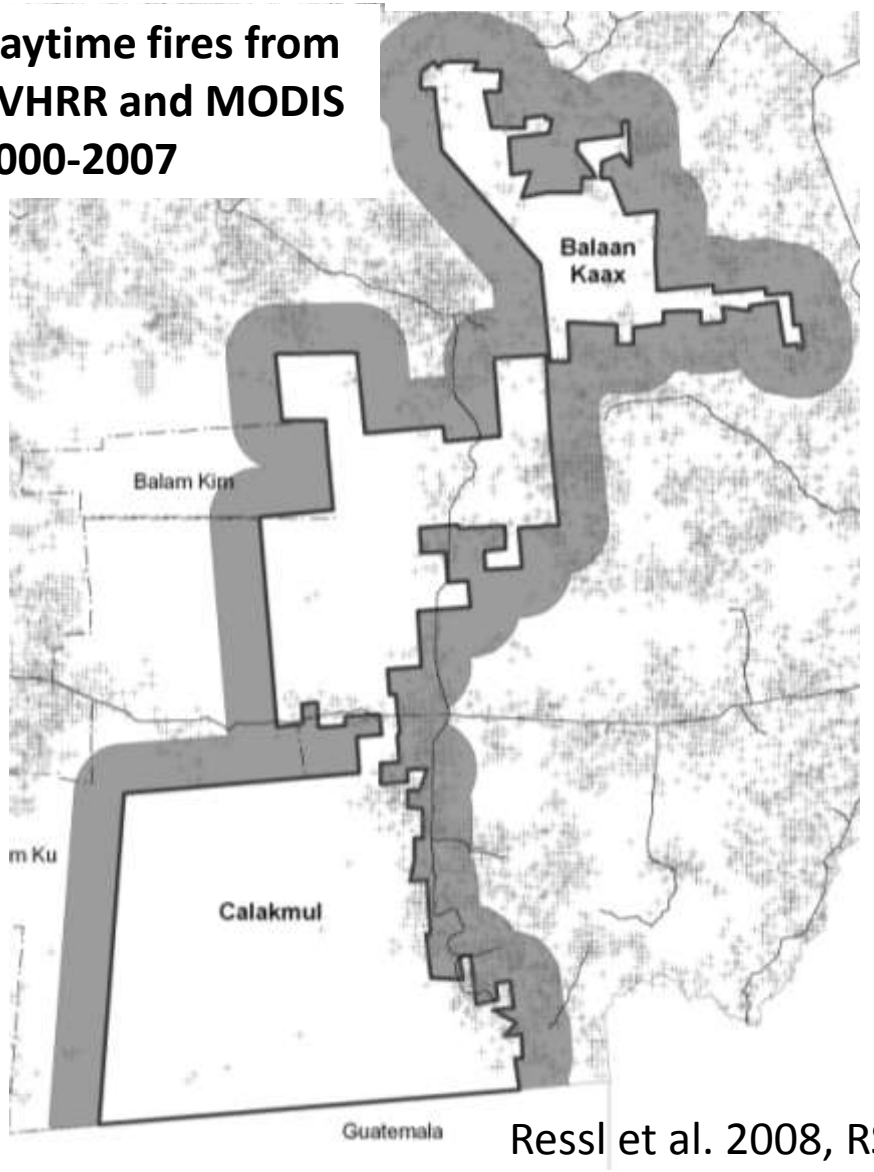


Change between 2005 and 2010
Colditz et al. PE&RS, 2014

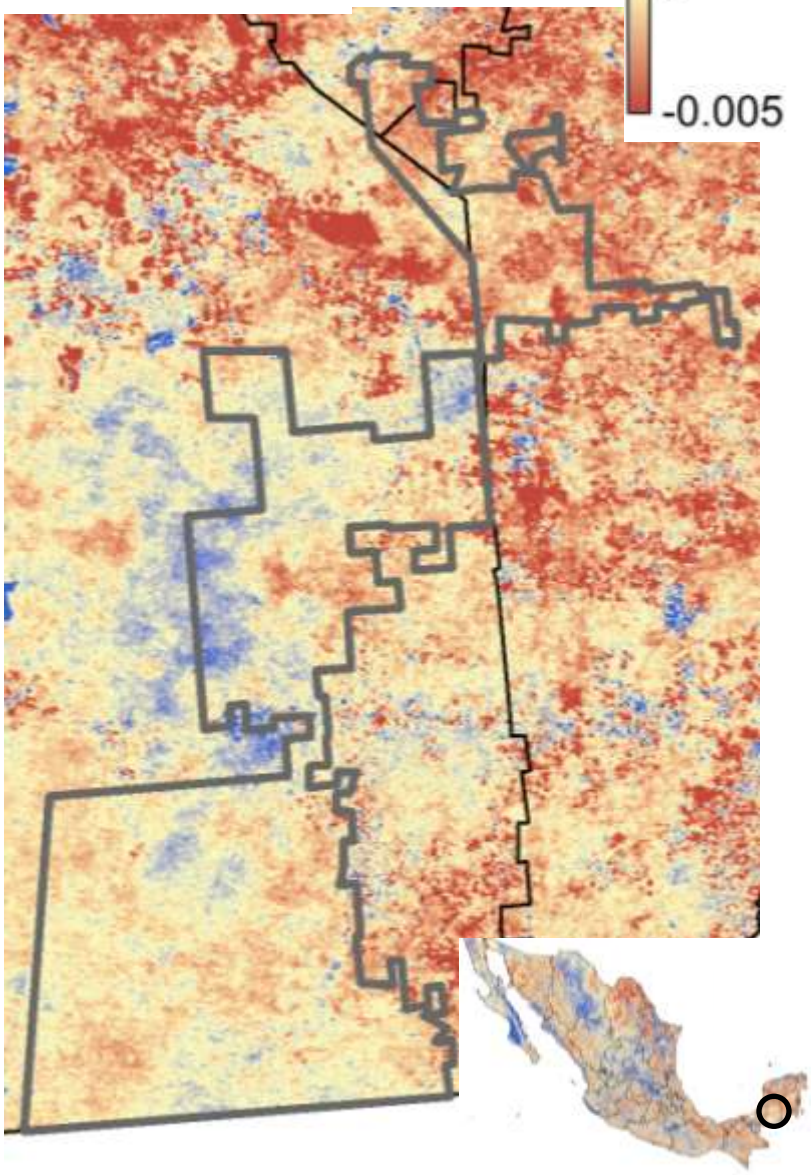
Trends – Southern Mexico

Natural Protected Area of Calakmul

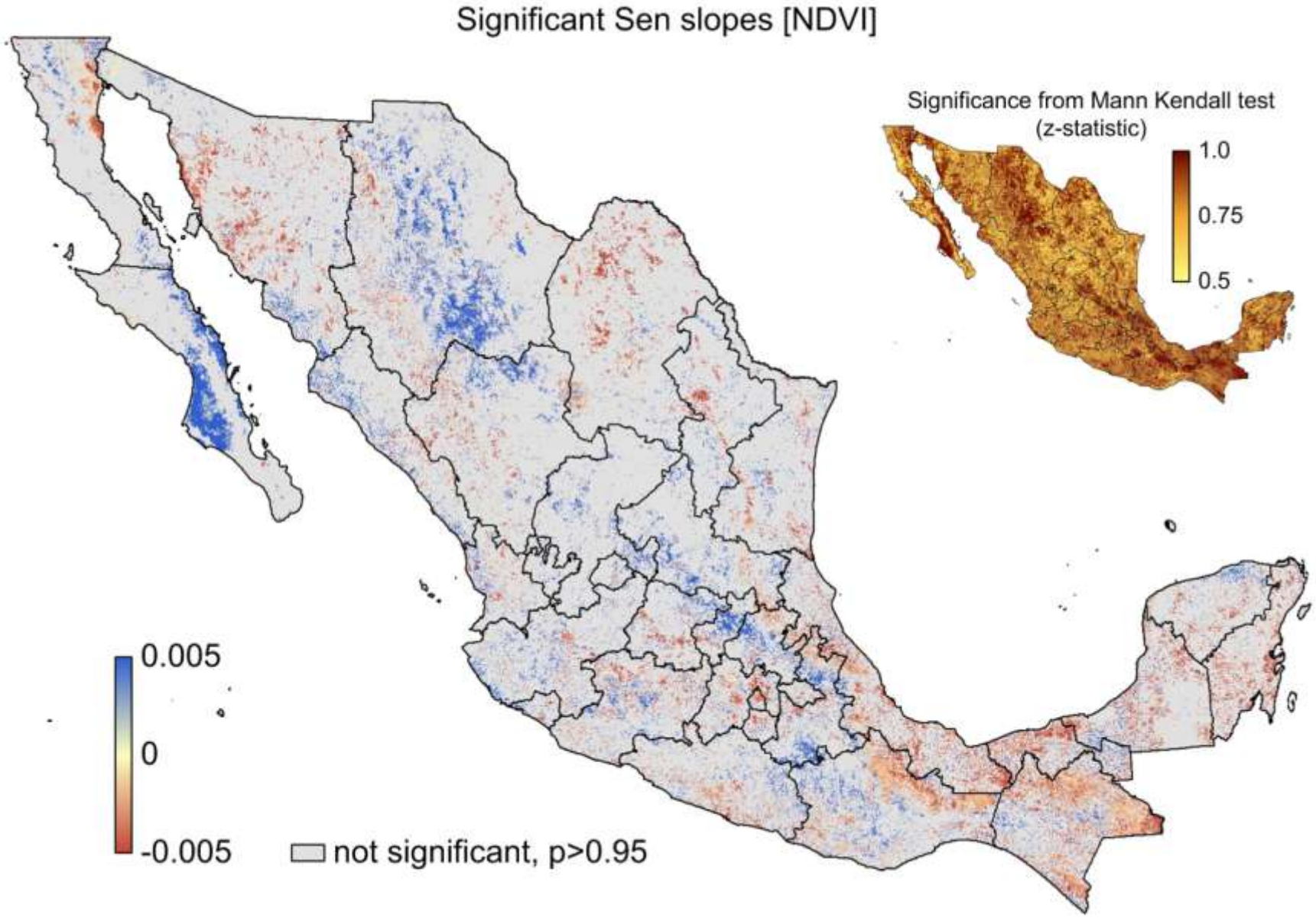
Daytime fires from AVHRR and MODIS 2000-2007



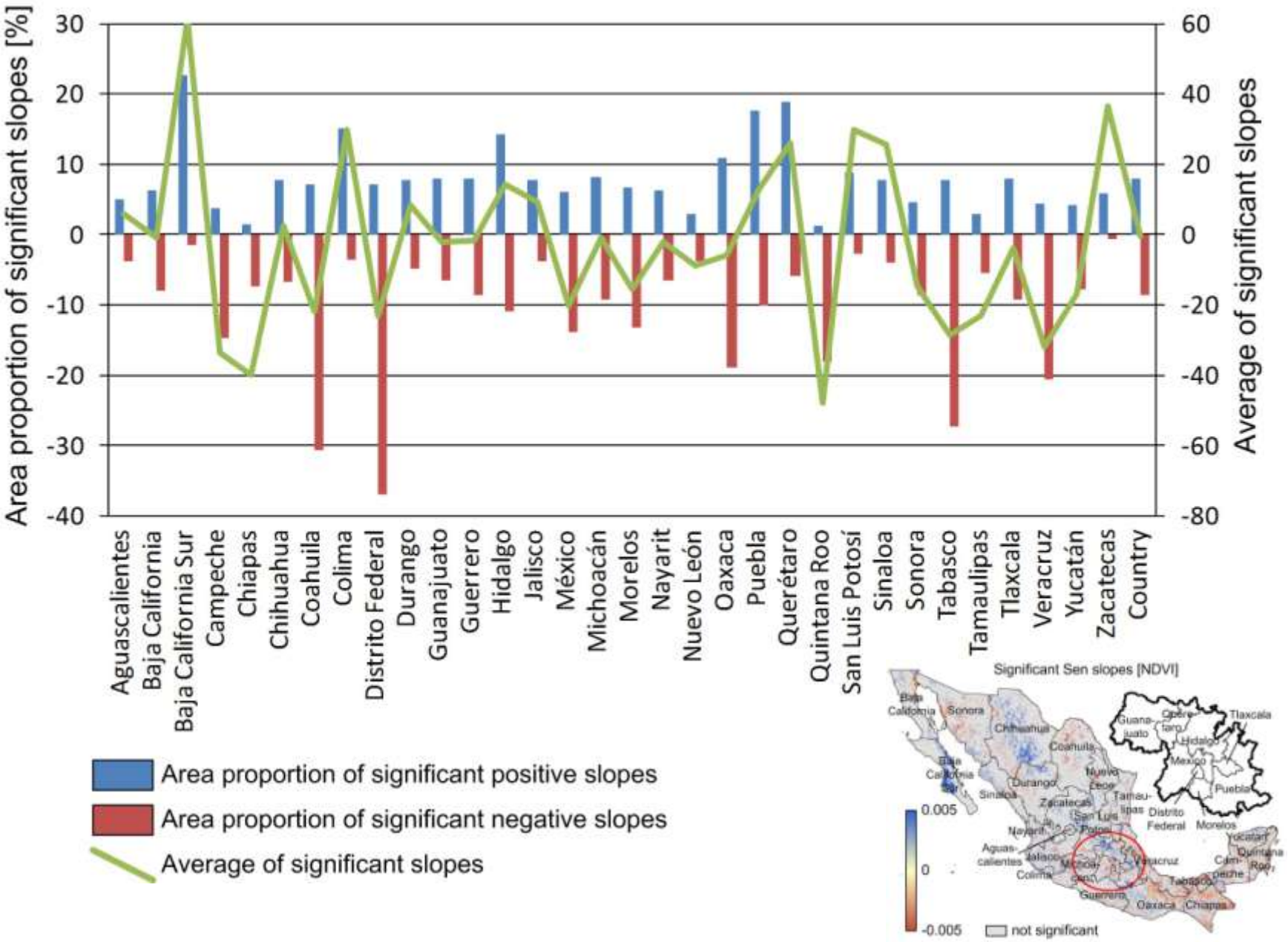
Ressl et al. 2008, RSE



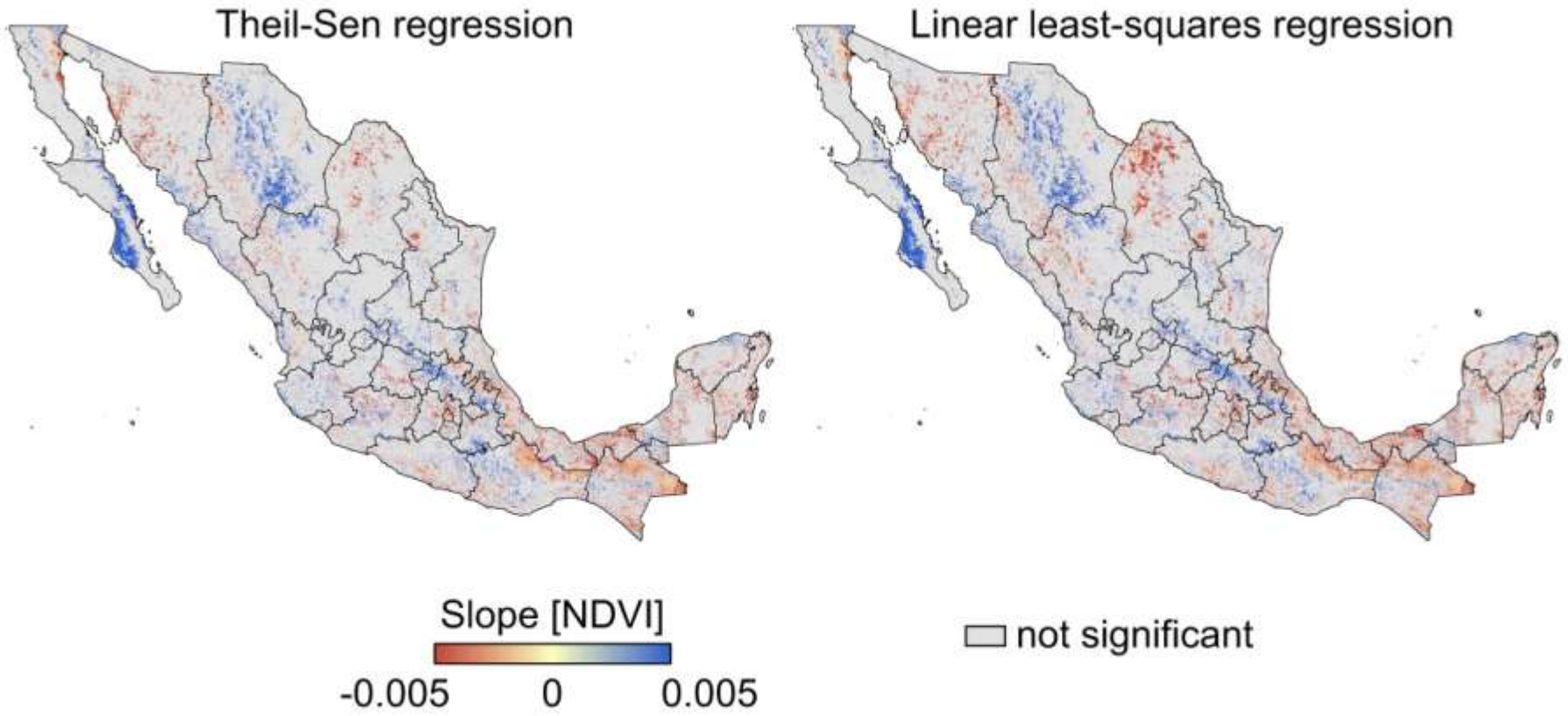
Slope significance



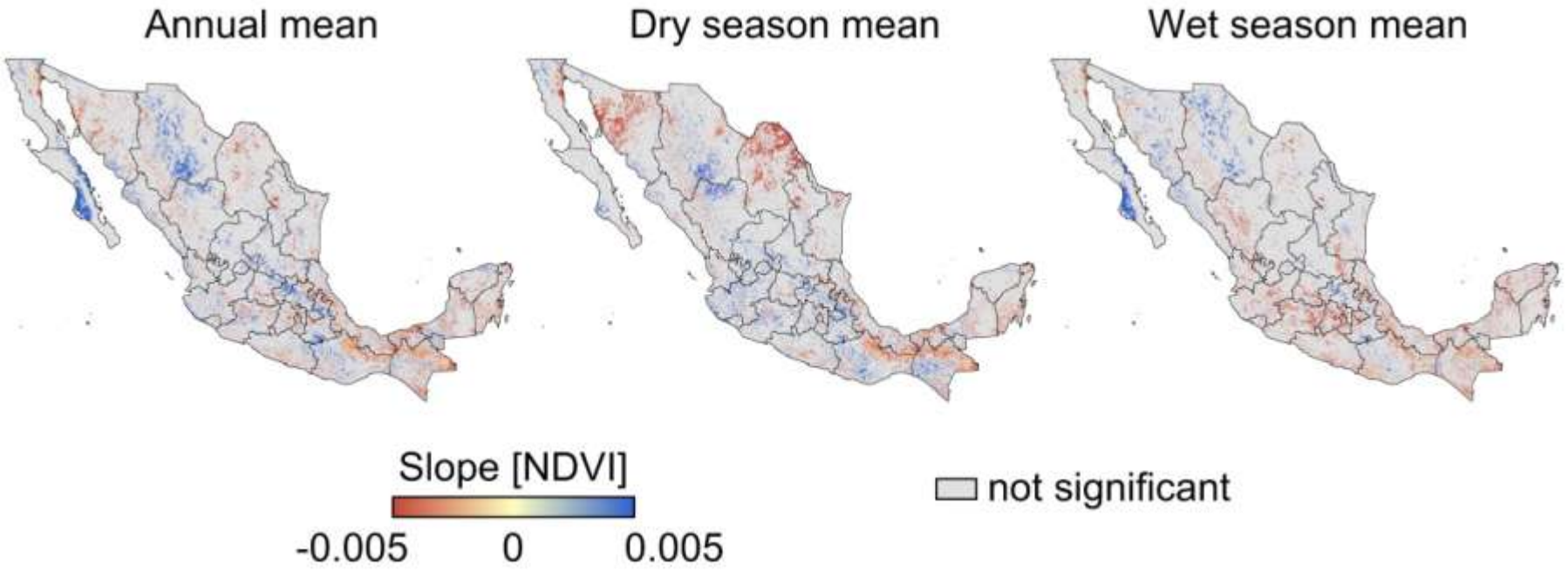
Area and mean trend



Sen-slope vs. Least-squares



Seasonal differences



Conclusions

- Trends relate to changes in land cover
  - Land abandonment in Northern Mexico
  - Tendencies in precipitation
  - Fires and Urbanization
  - Natural Protected Areas
- Few differences between linear least-squares and Theil-Sen regression
- Seasonal analysis supports finding change drivers

The road ahead

- Exploring further methods
  - Non-linear regression with pre-whitening to remote AR1 processes
  - Higher polynomials to account for changes over 15 years
  - Account for abrupt changes
- Build statistical link to land cover changes
- Extend study area to entire Latin America